Estimation of latent heat profiles using TRMM combined radar/radiometer measurements

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Scheduled for launch in late 1997, the Tropical Rainfall Measuring Mission satellite will include a 9-channel microwave radiometer and a 14 GHz radar. Combining the measurements of these two instruments over the intersection of their fields of view allows one to estimate the raindrop size distribution (DSD) as a function of altitude. This is made possible by parametrizing the DSD using one precipitating-liquid-volume variable and two "distribution shape" variables, derived from ground and airborne drop measurements. Because these shape parameters turn out to remain almost constant over spatial scales comparable to the TRMM radiometer field of view', the Bayesian approach which we have adopted permits us to find that liquid profile and those values of the shape parameters which are most consistent with the active and passive observations. The resulting estimates will be "optimal" in the sense that they minimize the r.m.s. error among all the possible solutions to the radiances-to-rainrate inversion problem. In fact, the Bayesian approach automatically estimates the variance corresponding to its estimates, thus producing a measure of the uncertainty in its "solution". From the vertical raindrop profiles, a straightforward model can estimate the heating budget, including the cooling due to rain evaporation and melting of ice, and the heating due to condensation of cloud water and, to a lesser extent, to deposition on frozen hydrometeors. The resulting latent heating profiles are important inputs to mesoscale and climate models.